

CLAIMS

1. A magnetic resonance radio frequency resonator that generates a radio frequency magnetic field in an active sample volume, the magnetic resonance radio frequency resonator comprising:
 - a dielectric substrate; and
 - a conductive material deposited on the dielectric substrate and forming a plurality of nested current carrying loops each of which has magnetic field generating elements and interdigital capacitor elements, the current carrying loops forming a substantially closed geometric path surrounding an inner region that lies adjacent to the active sample volume, wherein substantially all of the interdigital capacitor elements are oriented in a direction substantially parallel to the orientation of the magnetic field generating elements.
2. A magnetic resonance radio frequency resonator according to Claim 1 wherein the resonator is configured to be located in a static magnetic field in a particular orientation and, when in said particular orientation, the interdigital capacitor elements are oriented parallel to the static magnetic field.
3. A magnetic resonance radio frequency resonator according to Claim 1 wherein the conductive material is a superconductor.
4. A magnetic resonance radio frequency resonator according to Claim 1 wherein said inner region has a substantially oblong shape, and the magnetic field generating elements comprise electrical conductors that run substantially parallel to a major axis of the oblong shape.
5. A magnetic resonance radio frequency resonator according to Claim 4 wherein the interdigital capacitor elements comprise electrical conductors that run substantially parallel to said major axis of the oblong shape.

6. A magnetic resonance radio frequency resonator according to Claim 5 wherein the interdigital capacitor elements are located adjacent to the shorter sides of said oblong shape.
7. A magnetic resonance radio frequency resonator according to Claim 4 wherein the interdigital capacitor elements comprise conducting fingers separated by non-conducting gaps that also extend in a direction parallel to said major axis.
8. A magnetic resonance radio frequency resonator according to Claim 4 wherein the respective lengths of the magnetic field generating elements vary relative to their distance from a center of the oblong shape.
9. A magnetic resonance radio frequency resonator according to Claim 4 wherein the magnetic field generating elements further comprise lateral portions that run substantially perpendicular to said major axis, and that connect to respective interdigital capacitor elements.
10. A magnetic resonance radio frequency resonator according to Claim 4 wherein, together, a portion of said the conductors of the magnetic field generating elements that are located to one side of the oblong shape occupy a space having a substantially trapezoidal shape.
11. A magnetic resonance radio frequency resonator according to Claim 1 wherein the interdigital capacitor elements together make up a plurality of capacitors connected in series with the magnetic field generating elements.
12. A magnetic resonance radio frequency resonator that is located in a static magnetic field and that generates a radio frequency magnetic field in an active sample volume, the magnetic resonance radio frequency resonator comprising:
a dielectric substrate; and

a conductive material deposited on the dielectric substrate and forming a plurality of nested current carrying loops each of which has magnetic field generating elements and interdigital capacitor elements that are separate from the magnetic field generating elements and that generate electric field components, the current carrying loops forming a substantially closed geometric path surrounding an inner region that lies adjacent to the active sample volume, wherein the interdigital capacitor elements are oriented such that the square of the peak electric field in the direction of the static magnetic field is less than 10% of the peak of the sum of the squares of the electric field components in each of the two perpendicular directions.

13. A magnetic resonance radio frequency resonator according to Claim 12 wherein the conductive material is a superconductor.
14. A magnetic resonance radio frequency resonator according to Claim 12 wherein said inner region has a substantially oblong shape, and the magnetic field generating elements comprise electrical conductors that run substantially parallel to a major axis of the oblong shape.
15. A magnetic resonance radio frequency resonator according to Claim 14 wherein the interdigital capacitor elements comprise electrical conductors that run substantially parallel to said major axis of the oblong shape.
16. A magnetic resonance radio frequency resonator according to Claim 15 wherein the interdigital capacitor elements are located adjacent to the shorter sides of said oblong shape.
17. A magnetic resonance radio frequency resonator according to Claim 14 wherein the interdigital capacitor elements comprise conducting fingers separated by non-conducting gaps that also extend in a direction parallel to said major axis.

18. A magnetic resonance radio frequency resonator according to Claim 14 wherein the respective lengths of the magnetic field generating elements vary relative to their distance from a center of the oblong shape.
19. A magnetic resonance radio frequency resonator according to Claim 14 wherein the magnetic field generating elements further comprise lateral portions that run substantially perpendicular to said major axis, and that connect to respective interdigital capacitor elements.
20. A magnetic resonance radio frequency resonator according to Claim 14 wherein, together, a portion of said the conductors of the magnetic field generating elements that are located to one side of the oblong shape occupy a space having a substantially trapezoidal shape.
21. A magnetic resonance radio frequency resonator according to Claim 12 wherein the interdigital capacitor elements together make up a plurality of capacitors connected in series with the magnetic field generating elements.
22. A magnetic resonance radio frequency resonator that is located in a static magnetic field and that generates a radio frequency magnetic field in an active sample volume, the magnetic resonance radio frequency resonator comprising:
 - a dielectric substrate; and
 - a conductive material deposited on the dielectric substrate and forming a plurality of nested current carrying loops each of which has magnetic field generating elements and interdigital capacitor elements that are separate from the magnetic field generating elements, the current carrying loops forming a substantially closed geometric path surrounding an inner region that lies adjacent to the active sample volume, wherein substantially all of the interdigital capacitor elements are oriented in a direction substantially parallel to the direction of the static magnetic field.

23. A resonant magnetic field coil for an NMR spectrometer that generates a radio frequency magnetic field in an active sample volume, the coil comprising:
- a planar dielectric substrate; and
 - a high-temperature superconductor material deposited on the dielectric substrate and forming a plurality of nested current carrying loops each of which has magnetic field generating elements and interdigital capacitor elements, the current carrying loops forming a substantially closed geometric path surrounding an inner region that has a substantially oblong shape and lies adjacent to the active sample volume, wherein the magnetic field generating elements comprise electrical conductors that run substantially parallel to a major axis of the oblong shape and the interdigital capacitor elements comprise electrical conductors that run substantially parallel to said major axis of the oblong shape, and wherein substantially all of the interdigital capacitor elements are located farther from a center of the oblong shape than the magnetic field generating elements.
24. A method of making a magnetic resonance radio frequency resonator that generates a radio frequency magnetic field in an active sample volume, the method comprising:
- providing a planar dielectric substrate; and
 - depositing a conductive material on the dielectric substrate to form a plurality of nested current carrying loops each of which has magnetic field generating elements and interdigital capacitor elements, the current carrying loops forming a substantially closed geometric path surrounding an inner region that lies adjacent to the active sample volume, wherein substantially all of the interdigital capacitor elements are oriented in a direction substantially parallel to the orientation of the magnetic field generating elements.
25. A method according to Claim 24 wherein the resonator is configured to be located in a static magnetic field in a particular orientation and, when in said

particular orientation, the interdigital capacitor elements are oriented parallel to the static magnetic field.

26. A method according to Claim 24 wherein the conductive material is a superconductor.
27. A method according to Claim 24 wherein said inner region has a substantially oblong shape, and the magnetic field generating elements comprise electrical conductors that run substantially parallel to a major axis of the oblong shape.
28. A method according to Claim 27 wherein the interdigital capacitor elements comprise electrical conductors that run substantially parallel to said major axis of the oblong shape.
29. A method according to Claim 28 wherein the interdigital capacitor elements are located adjacent to the shorter sides of said oblong shape.
30. A method according to Claim 27 wherein the interdigital capacitor elements comprise conducting fingers separated by non-conducting gaps that also extend in a direction parallel to said major axis.
31. A method according to Claim 27 wherein the respective lengths of the magnetic field generating elements vary relative to their distance from a center of the oblong shape.
32. A method according to Claim 27 wherein the magnetic field generating elements further comprise lateral portions that run substantially perpendicular to said major axis, and that connect to respective interdigital capacitor elements.

33. A method according to Claim 27 wherein, together, a portion of said the conductors of the magnetic field generating elements that are located to one side of the oblong shape occupy a space having a substantially trapezoidal shape.
34. A method according to Claim 24 wherein the interdigital capacitor elements together make up a plurality of capacitors connected in series with the magnetic field generating elements.